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Environmental Radioactivity Laboratory Intercomparison Studies Program Fiscal Year 1980-1981

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Las Vegas, NV

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Environmental Radioactivity Laboratory Intercomparison Studies Program Fiscal Year 1981-1982

prepared for the
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Office of Water Planning and Standards,
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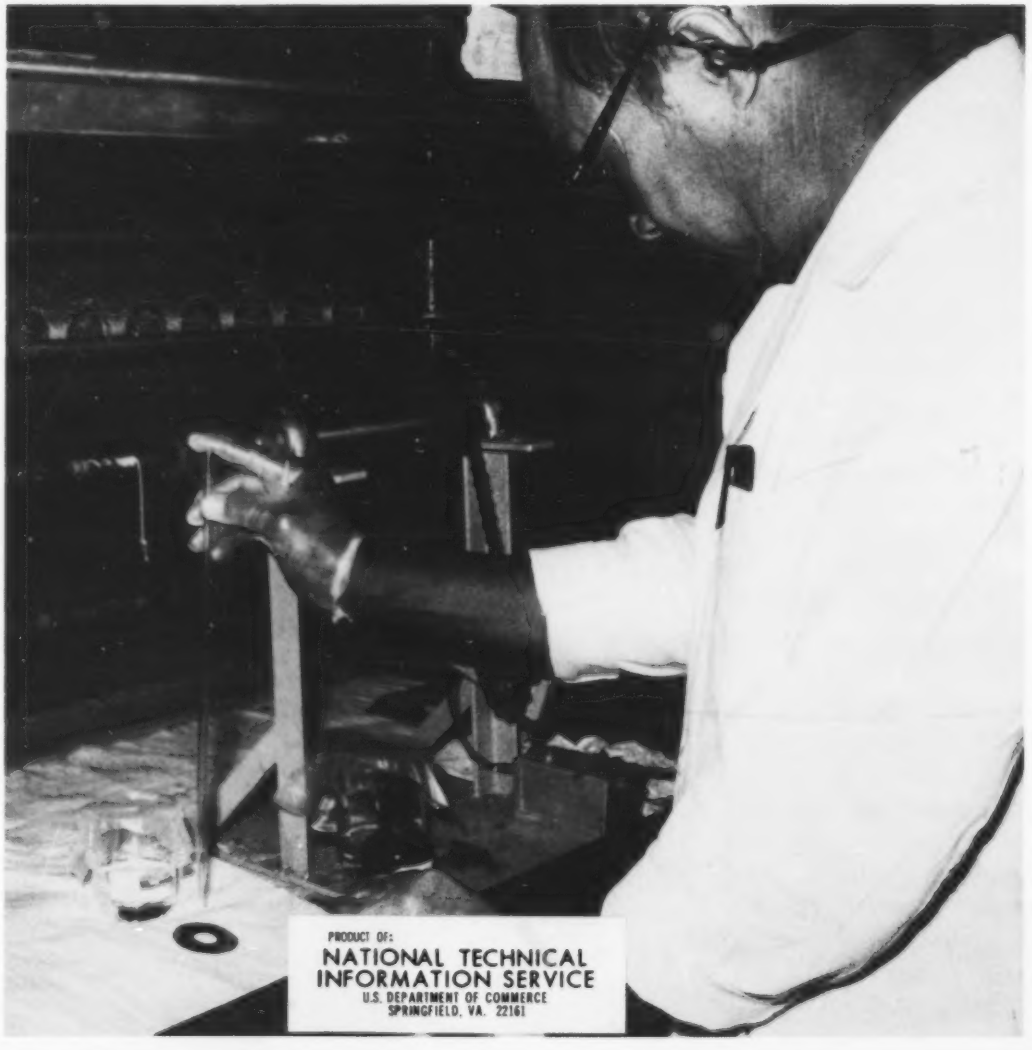

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16. ABSTRACT

The U.S. Environmental Protection Agency's intercomparison studies program for laboratories involved in environmental radiation measurements is described. The types of environmental samples distributed, the analyses required for each sample, the distribution schedule, and the statistical analysis and reporting of results are discussed. Instructions and application forms are included for laboratories desiring to participate in the program.

This document is not a research report. It is designed for use by laboratories participating or desiring to participate in the quality assurance program.

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ENVIRONMENTAL RADIOACTIVITY
LABORATORY INTERCOMPARISON STUDIES PROGRAM
FISCAL YEAR 1981-1982

by

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Las Vegas, Nevada 89114

prepared for the
Office of Drinking Water
and the
Office of Radiation Programs

ENVIRONMENTAL MONITORING SYSTEMS LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
LAS VEGAS, NEVADA 89114

DISCLAIMER

This report has been reviewed by the Environmental Monitoring Systems Laboratory-Las Vegas, U.S. Environmental Protection Agency, and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

FOREWORD

This document, which is essentially a catalog, describes the types, concentration, and frequency of distribution of radioactive performance samples available from EPA's Environmental Monitoring Systems Laboratory in Las Vegas. It indicates the procedures used in the laboratory intercomparison studies and provides forms for requesting the samples.

The catalog is distributed to over 200 laboratories (Regional, State, nuclear facility, National, commercial, and international) that are involved in environmental radiation measurements. These laboratories, and any others that wish to participate in EPA's quality assurance program for radiation measurements, are encouraged to use the laboratory intercomparison samples described in this catalog for maintaining a quality control program and for documenting the precision and accuracy of their data.

Glenn E. Schweitzer
Director
Environmental Monitoring Systems Laboratory
Las Vegas, Nevada

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THE LABORATORY INTERCOMPARISON STUDIES PROGRAM

Environmental measurements of radiation are made daily by many Federal, State, local, and private agencies. The data from these measurements are used for a wide variety of purposes including assessment of health effects, the establishment of standards and guides, and enforcement activities. It is imperative that the precision and accuracy of the data be assured so that decisions concerning environmental quality or impact are based on data of known reliability.

An Agency-wide quality assurance program has been implemented within the U.S. Environmental Protection Agency (EPA) to attain this goal. Radiation quality control responsibilities have been assigned to the Quality Assurance Division at the EPA's Environmental Monitoring Systems Laboratory-Las Vegas (EMSL-LV), Las Vegas, Nevada. A program has been instituted to encourage the development and implementation of quality control procedures for sample collection, laboratory analysis, and data handling and reporting.

A major objective of this program is to assist laboratories involved in environmental radiation measurements to develop and maintain both an intra-laboratory and an interlaboratory quality control program. In part, this is accomplished through an extensive laboratory intercomparison studies program involving environmental media (milk, water, air and food) and a variety of radionuclides with activities at or near environmental levels.

Simulated environmental samples, containing known amounts of one or more radionuclides, are prepared and periodically distributed to laboratories upon request. These laboratories perform the required analyses and return their data to the Quality Assurance Division for statistical analysis and comparison with known values as well as analytical values obtained by other participating laboratories. A report is returned to each participant. The program thus enables each laboratory to document the precision and accuracy of its radiation data, identify instrument and procedural problems, and to compare its performance with that of other laboratories.

Each laboratory making environmental radiation measurements should have an internal quality control program in operation to ensure that all instrumentation is calibrated and functioning, and that analytical procedures are being carried out properly. Such a program includes continual monitoring of instrumentation, the plotting of instrument control charts, frequent analysis of replicate samples to check precision, and the regular measurement of samples to which known amounts of activity have been added to check the accuracy of systems.

Participation in a laboratory intercomparison study does not automatically assure the precision and accuracy of a laboratory's data and should not be considered as a substitute for a continuous quality control program within a laboratory. Intercomparison data may be useful for documenting precision and accuracy, and helping to indicate instrument or procedural problems. Participation in intercomparison studies is useful in augmenting a laboratory's quality control program by serving as a check on its internal quality control program.

TYPES OF ENVIRONMENTAL SAMPLES DISTRIBUTED

The current laboratory intercomparison studies program includes the analysis of a variety of media containing various levels of radioactivity. These include:

Water: Water containing several different mixtures of radioactive materials is included in the Laboratory Intercomparison Study. For example:

- Four-liter samples for the analysis of gross alpha and gross beta activity are sent bimonthly to participating laboratories.
- Four-liter samples containing chromium-51, zinc-65, cobalt-60, ruthenium-106, cesium-134, and cesium-137 are distributed bimonthly for analysis of gamma emitters.
- Fifty-milliliter samples for tritium analysis are distributed on a bimonthly basis.
- Four-liter samples containing plutonium-239 are shipped to laboratories twice per year.
- Four-liter samples containing iodine-131 are distributed three times per year.
- Four-liter samples containing radium-226 and radium-228 are distributed four times per year.
- Four-liter samples containing strontium-89 and strontium-90 are distributed three times per year.
- Four-liter blind samples containing a mixture of radionuclides are distributed semiannually.
- Four-liter samples containing uranium-238 are distributed twice per year.

Milk: Four-liter milk samples containing potassium, strontium-89, strontium-90, iodine-131, cesium-137, and barium-140 are distributed quarterly.

Air: Two-inch diameter air filters are distributed quarterly for gross alpha, gross beta cesium-137, and strontium-90 analyses. Three air filters are sent to each laboratory.

Diet: Four-liter food slurry samples containing strontium-89, strontium-90, iodine-131, cesium-137, barium-140, and potassium are sent to participants three times per year. Two samples are sent to each laboratory.

Urine: Fifty-milliliter urine samples containing tritium are distributed quarterly.

Sample size, approximate activity levels, type of analysis, and other pertinent information concerning the intercomparison samples are summarized in Table 1. The distribution schedule is outlined in Table 2.

ANALYSIS OF DATA

Each participating laboratory is expected to perform three independent determinations for each radionuclide included in a study and to report their analytical results on a form (Figure 1) provided with the sample.

After receipt of reports from all the participating laboratories, a letter giving the known value for each radionuclide is mailed to participants. The data reported by all participating laboratories are transferred to punch cards for computer analysis. As indicated in the sample calculations below, this analysis includes determination of the laboratory standard deviation, calculation of the normalized range, normalized deviation, sample standard deviation, and the grand average of all laboratories. The analytical precision values, used as a basis for judging laboratory performance for specific nuclides, are summarized in Table 3. A report is generated containing data reported by participating laboratories, listed according to their identity code, along with the results of the analysis (Figure 2). Each participant receives a copy of the report.

TABLE 1. SUMMARY OF LABORATORY INTERCOMPARISON STUDIES*

Sample	Analysis	Activity per Isotope	Quantity Supplied	Preservative	Distribution	Time for Analysis & Report
Milk	^{89}Sr, ^{90}Sr, ^{131}I, ^{137}Cs, ^{140}Ba, K	<200 pCi/liter	∿4 liters	Formalin	quarterly	10 weeks
Water						
Gross α,β*	Gross α,β	<100 pCi/liter	∿4 liters	0.5N HNO_3	bimonthly	4 weeks
Gamma	^{60}Co, ^{106}Ru, ^{134}Cs, ^{131}I, ^{137}Cs, ^{51}Cr, ^{65}Zn	<500 pCi/liter	∿4 liters	0.5N HNO_3	bimonthly	6 weeks
^{3}H	^{3}H	<3,500 pCi/liter	∿50 ml	none	bimonthly	4 weeks
^{239}Pu*	^{239}Pu	<10 pCi/liter	∿4 liters	0.5N HNO_3	semiannually	8 weeks
Radium	^{226}Ra, ^{228}Ra	<20 pCi/liter	∿4 liters	0.5N HNO_3	quarterly	8 weeks
Strontium	^{89}Sr, ^{90}Sr	<50 pCi/liter	∿4 liters	0.5N HNO_3	triannually	10 weeks
Blind	Any combination of above radionuclides	<200 pCi/liter	∿4 liters	0.5N HNO_3	semiannually	10 weeks
^{131}I	^{131}I	<50 pCi/liter	∿4 liters	$NaHSO_3$, Na_2CO_3	triannually	6 weeks
Uranium	Total uranium	<50 pCi/liter	∿4 liters	0.5N HNO_3	semiannually	6 weeks
Air filter	Gross α, β* ^{90}Sr, ^{137}Cs	<200 pCi/sample	3 - 2" diameter air filters	none	quarterly	10 weeks
Diet	^{89}Sr, ^{90}Sr, ^{131}I, ^{137}Cs, ^{140}Ba, K	<200 pCi/kg	2 - 4-liter samples	Formalin	triannually	10 weeks
Urine	^{3}H	<3,500 pCi/liter	∿50 ml	Formalin	quarterly	4 weeks

*Laboratories are required to have the necessary licenses before receiving these samples.

TABLE 2. LABORATORY INTERCOMPARISON STUDY DISTRIBUTION SCHEDULE
(Numbers indicate week of the month.)

	Water									Milk	Food	Urine	Air Filter
Month	γ	^{131}I	Gross α, β	^{3}H	^{226}Ra ^{228}Ra	^{239}Pu	^{89}Sr ^{90}Sr	^{238}U	Blind*	Sr,γ	Sr,γ	^{3}H	Gross α, β ^{137}Cs, ^{90}Sr
October	1			2					3	4			
November			3								1		
December		1		2	3							2	4
January			3			2	1			4			
February	1			2				3					
March			3		2						1	3	4
April		1		2					3	4			
May			3				1						
June	1			2	3							2	4
July			3			2				4	1		
August		1		2				3					
September			3		2		1					3	4

*Performance sample for the Water Supply Laboratory Certification Program

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT

ENVIRONMENTAL MONITORING
SYSTEMS LABORATORY
P O BOX 15027
LAS VEGAS, NEVADA 89114
702/798-2100 (FTS 595-2100)

Quality Assurance Division
Analysis Results
Tritium in Water Cross-Check Program

Laboratory _____

_____

_____

Contact Person _____

Phone _____ Collection Date _____

Important: Report results corrected for decay as of the collection date.

Please refer to instructions on back of page.

	Lab Code		Do Not Use This Space				Iso tope	Analysis #1														Analysis #2														Analysis #3														Units
	1	2	3	4	5	6	7		11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40										
1							1	3H										●										●										●												pCi/l

In order to be included in the final report, please send your results no later than _____ to:

U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory
Quality Assurance Division
P.O. Box 15027
Las Vegas, NV 89114

Figure 1. Example of a results report form.

REPORT SHEET INSTRUCTIONS

1. Legibly type or print numbers and letters in the proper squares. Use only capital letters.

2. Record lab code in columns 1 and 2 for each isotope (one isotope per line). For a code of only one letter, use column 1.

3. Slash the letters Ø and Z. Do not slash any numbers.

4. Do not use columns 3-7; they are for internal use only.

5. Data entry: (columns 11-40)

   a. All numbers must be right justified (entered to far right of field).

   b. For statistical purposes, it is important that each laboratory report three results for each radionuclide. If, for some unavoidable reason, less than three values are reported, record the data starting with the columns reserved for analysis #1 and work to the right.

   c. Report results to the nearest whole number with the exceptions of tritium and potassium (each recorded to multiples of ten) and radium-226 (recorded to one decimal place). Decimal points are provided on the report forms.

   d. Each line of the coding form contains the name of the isotope and its unit of activity, preprinted for your convenience. Each line should contain information pertaining to just that one isotope.

   e. If a value is less than (LT) the minimum detectable activity (MDA), record LT, space, then the MDA value (right justified).

Figure 1 (continued). Results report form.

TABLE 3. LABORATORY PRECISION: ONE STANDARD DEVIATION VALUES FOR VARIOUS ANALYSES

Analysis	Level	One Standard Deviation for Single Determination
Gamma Emitters	5 to 100 pCi/liter or kg >100 pCi/liter or kg	5 pCi/liter 5% of known value
Strontium-89	5 to 100 pCi/liter or kg >100 pCi/liter or kg	5 pCi/liter 5% of known value
Strontium-90	2 to 30 pCi/liter or kg >30 pCi/liter of kg	1.5 pCi/liter 5% of known value
Potassium	$\geq$0.1 g/liter or kg	5% of known value
Gross Alpha	$\leq$20 pCi/liter >20 pCi/liter	5 pCi/liter 25% of known value
Gross Beta	$\leq$100 pCi/liter >100 pCi/liter	5 pCi/liter 5% of known value
Tritium	<4,000 pCi/liter >4,000 pCi/liter	1s (pCi/liter) = 169.85 x (known)$^{.0933}$ 10% of known value
Radium-226, Radium-228	$\leq$0.1 pCi/liter	15% of known value
Plutonium	0.1 pCi/liter, gram or sample	10% of known value
Iodine-131	$\leq$55 pCi/liter >55 pCi/liter	6 pCi/liter 10% of known value
Uranium-238	$\leq$35 pCi/liter >35 pCi/liter	6 pCi/liter 15% of known value

EMSL-LV TRITIUM IN URINE CROSS-CHECK PROGRAM --- SEPTEMBER 1974

09/20/74 SAMPLE - A 3H

KNOWN VALUE = 3273 PCI/L
EXPECTED LABORATORY PRECISION (1S, 1 DETERMINATION) = 357 PCI/L

LAB	RESULT	EXPERIMENTAL SIGMA	RNG ANLY ($\bar{R}$ + SR)	AVERAGE	NORMALIZED DEVIATION (GRAND AVG)	(KNOWN)
AN	NO DATA PROVIDED					
CF	3269					
CF	3522					
CF	3632	186.1	.60	3474	.9	1.0
CM	3261					
CM	3373					
CM	3362	61.7	.19	3332	.2	.3
CO	NO DATA PROVIDED					
D	3060					
D	3060					
D	3240	103.9	.30	3120	-.8	-.7
J	3255					
J	3247					
J	3294	25.1	.08	3265	-.1	-.0
P	NO DATA PROVIDED					
Z	3240					
Z	3340					
Z	3190	76.4	.25	3257	-.2	-.1

EXPERIMENTAL SIGMA (ALL LABS) = 149 GRAND AVERAGE = 3290

Figure 2. Example of a sample analysis and report of participant's data.

Explanation of terms in Figure 2:

Title:	Program name, sample collection date, sample code letter, analysis type, known concentration of radionuclide, expected standard deviation of analysis - single determination.
Column 1:	Laboratory identification code (A, B, C, etc.).
Column 2:	Laboratory results (0-25 results listed down column).
Column 3:	Standard deviation (1s) of the experimental results.
Columns 4 and 5:	Normalized range value in "mean range + standard error of the range" ($\bar{R} + \sigma_R$) units for comparability. (See *Statistical Techniques for Quality Control of Environmental Radioassay*, AQCS Report Stat-1, November 1964, pages 4-8.) ($S_R = \sigma_R$ for printing purposes.)
Column 6:	Average value.
Column 7:	Normalized deviation from the grand average value of all laboratories expressed in $_m$ units.
Column 8:	Normalized deviation from the known value expressed in σ_m units.
Bottom of Chart:	Experimental sigma (1s) of all laboratories, and the grand average of all laboratories.

PARTICIPATION IN THE LABORATORY INTERCOMPARISON STUDIES PROGRAM

Any laboratory involved in, or concerned with, environmental radiation monitoring and surveillance is eligible to participate in any one or all of the studies described. There is no cost to participating laboratories for this service. A laboratory may elect to receive samples on a less frequent basis than indicated on the distribution schedule (Table 2).

To become a participant in the laboratory intercomparison studies program, complete one of the forms included at the end of this publication and return to:

U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory
Quality Assurance Division
P.O. Box 15027
Las Vegas, NV 89114

STATISTICAL CALCULATIONS

To illustrate the computations performed by the computer, example calculations are given using data for three samples analyzed at one laboratory (Laboratory D, see Figure 2).

The experimental data are listed and the mean, experimental sigma and range are computed. These statistics provide measures of the central tendency and dispersion of the data.

The normalized range is computed by first finding mean range, $\bar{R}$, the control limit, CL, and the standard error of the range, σ_R. The normalized range measures the dispersion of the data (precision) in such a form that control charts may be used. Control charts allow one to readily compare past analytical performance with present performance. In the example, the normalized range equals 0.3 which is less than 3, which is the upper control level. The precision of the results is acceptable.

The normalized deviation is calculated by computing the deviation and the standard error of the mean, σ_m. The normalized deviation allows one to readily measure central tendency (accuracy) through the use of control charts. Trends in analytical accuracy can be determined in this manner. For this example, the normalized deviation is -0.7 which falls between +2 and -2, which are the upper and lower warning levels. The accuracy of the data is acceptable.

Finally, the experimental error of all laboratories, the grand average, and the normalized deviation from the grand average are calculated in order to ascertain the performance of all the laboratories as a group. Any bias in methodology or instrumentation may be indicated by these results.

EXAMPLE CALCULATIONS (Laboratory D Data, see Figure 2)

Experimental data:

Known value = μ = 3273 pCi ^{3}H/liter urine on September 24, 1974

Expected laboratory precision = σ = 357 pCi/liter

Laboratory	Sample	Result
D	x_1	3060 pCi/liter
D	x_2	3060 pCi/liter
D	x_3	3240 pCi/liter

Mean = $\bar{x}$

$$\bar{x} = \frac{\sum_{i=1}^{N} x_i}{N} = \frac{9360}{3} = 3120 \text{ pCi/liter}$$

where N = number of results = 3

Experimental sigma = s

$$s = \sqrt{\frac{\sum_{i=1}^{N} (x_i)^2 - \frac{\left(\sum_{i=1}^{N} x_i\right)^2}{N}}{N - 1}}$$

$$s = \sqrt{\frac{(3060)^2 + (3060)^2 + (3240)^2 - \frac{(3060 + 3060 + 3240)^2}{3}}{2}}$$

$$s = 103.9 \text{ pCi/liter}$$

Range = r

$$r = \left| \text{maximum result} - \text{minimum result} \right|$$

$$r = \left| 3240 - 3060 \right| = 180 \text{ pCi/liter}$$

Range Analysis (RNG ANLY)*

Mean range = $\bar{R}$

$\bar{R} = d_2\sigma$ where d_2** = 1.693 for N = 3

$= (1.693)(357)$

$\bar{R} = 604.4$ pCi/liter

Control limit = CL

$CL = \bar{R} + 3\sigma_R$

$= D_4\bar{R}$ where D_4** = 2.575 for N = 3

$= (2.575)(604.4)$

$CL = 1556$ pCi/liter

Standard error of the range = σ_R

$\sigma_R = (\bar{R} + 3\sigma_R - \bar{R}) \div 3$

$= (D_4\bar{R} - \bar{R}) \div 3$

$= (1556 - 604.4) \div 3$

$\sigma_R = 317.2$ pCi/liter

Let range = $r = w\bar{R} + x\sigma_R = 180$ pCi/liter

Define normalized range = $w + x$

for $r > \bar{R}$, $w = 1$

then $r = w\bar{R} + x\sigma_R = \bar{R} + x\sigma_R$

or $x = \dfrac{r - \bar{R}}{\sigma_R}$

therefore $w + x = 1 + x = 1 + \dfrac{r - \bar{R}}{\sigma_R}$

---

* Rosenstein, M., and A. S. Goldin, "Statistical Techniques for Quality Control of Environmental Radioassay," AQCS Report Stat-1, U.S. Department of Health, Education and Welfare, PHS, Nov 1964

** From table "Factors for Computing Control Limits," Handbook of Tables For Probability and Statistics, 2nd Edition, The Chemical Rubber Co., Cleveland, OH, 1968, p 454.

for $r \leq \bar{R}$, $x = 0$

then $r = w\bar{R} + x\sigma_R = w\bar{R}$

or $w = \frac{r}{\bar{R}}$

therefore $w + x = w + 0 = \frac{r}{\bar{R}}$

since $r < \bar{R}$, $(180 < 604.4)$

$$w + x = \frac{180}{604.4}$$

$$w + x = 0.30$$

Normalized deviation of the mean from the known value = ND

Deviation of mean from the known value = D

$$D = \bar{x} - \mu$$

$$= 3120 - 3273$$

$$D = -153 \text{ pCi/liter}$$

Standard error of the mean = σ_m

$$\sigma_m = \frac{\sigma}{\sqrt{N}}$$

$$= \frac{357}{\sqrt{3}}$$

$$\sigma_m = 206.1 \text{ pCi/liter}$$

$$ND = \frac{D}{\sigma_m}$$

$$= \frac{-153}{206.1}$$

$$ND = -0.7$$

Control limit = CL

$CL = (\mu \pm 3\sigma_m)$

Warning Limit = WL

$WL = (\mu \pm 2\sigma_m)$

Experimental sigma (all laboratories)' = s_t (See Figure 2)

$$s_t = \sqrt{\frac{\sum_{i=1}^{N} (x_i)^2 - \frac{\left(\sum_{i=1}^{N} x_i\right)^2}{N}}{N - 1}}$$

$$= \sqrt{\frac{162639133 - \frac{(49345)^2}{15}}{14}}$$

$$s_t = 149 \text{ pCi/liter}$$

Grand average = GA

$$GA = \frac{\sum_{i=1}^{N} x_i}{N}$$

$$= \frac{49345}{15}$$

$$GA = 3290 \text{ pCi/liter}$$

Normalized deviation from the grand average = ND'

Deviation of the mean from the grand average = D'

$$D' = \bar{x} - GA$$

$$= 3120 - 3290$$

$$D' = - 170 \text{ pCi/liter}$$

$$ND' = \frac{D'}{\sigma_m}$$

$$= \frac{- 170}{206.1}$$

$$ND' = - 0.8$$

SUBJECT: Participation in Intercomparison Studies Program

TO: U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory
Quality Assurance Division
P.O. Box 15027
Las Vegas, NV 89114

Please include our laboratory in the cross-check studies we have indicated below. All samples are to be shipped to:

Contact Person _____

Title _____

Laboratory _____

Address _____

NRC License

and/or Type(s) _____

State License Number(s) _____

NOTE: When requesting participation in a study containing either nuclear byproducts or special nuclear materials, a copy of the NRC license(s) must accompany the request.

Please indicate desired frequency of participation.

	FREQUENCY DESIRED				
	BIMONTHLY	QUARTERLY	TRIANNUALLY	SEMIANNUALLY	ANNUALLY
Milk: Sr, γ		☐		☐	☐
Water:					
Gross α, β	☐	☐		☐	☐
γ	☐	☐		☐	☐
^{3}H	☐	☐		☐	☐
^{239}Pu				☐	☐
^{226}Ra, ^{228}Ra		☐		☐	☐
Blind				☐	☐

	FREQUENCY DESIRED			
	QUARTERLY	TRIANNUALLY	SEMIANNUALLY	ANNUALLY
Water (continued):				
^{89}Sr, ^{90}Sr		☐	☐	☐
^{131}I		☐	☐	☐
^{238}U			☐	☐
Diet: Sr, γ		☐	☐	☐
Air Filter:				
Gross α, β	☐		☐	☐
^{137}Cs, ^{90}Sr				

I certify this laboratory is authorized to receive the samples requested.

Signature _____

Date _____ Title _____

SUBJECT: Participation in Intercomparison Studies Program

TO: U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory
Quality Assurance Division
P.O. Box 15027
Las Vegas, NV 89114

Please include our laboratory in the cross-check studies we have indicated below. All samples are to be shipped to:

Contact Person _____

Title _____

Laboratory _____

Address _____

NRC License
and/or Type(s) _____
State License Number(s) _____

NOTE: When requesting participation in a study containing either nuclear byproducts or special nuclear materials, a copy of the NRC license(s) must accompany the request.

Please indicate desired frequency of participation.

	FREQUENCY DESIRED									
	BIMONTHLY	QUARTERLY	TRIANNUALLY	SEMIANNUALLY	ANNUALLY		QUARTERLY	TRIANNUALLY	SEMIANNUALLY	ANNUALLY
Milk: Sr, γ		☐		☐	☐	Water (continued):				
Water:						^{89}Sr, ^{90}Sr		☐	☐	☐
Gross α, β	☐	☐		☐	☐	^{131}I		☐	☐	☐
γ	☐	☐		☐	☐	^{238}U			☐	☐
^{3}H	☐	☐		☐	☐	Diet: Sr, γ		☐	☐	☐
^{239}Pu				☐	☐	Air Filter:				
^{226}Ra, ^{228}Ra		☐		☐	☐	Gross α, β	☐		☐	☐
Blind				☐	☐	^{137}Cs, ^{90}Sr				

I certify this laboratory is authorized to receive the samples requested.

Signature _____

Date _____ Title _____